



United States Department of the Interior

FISH AND WILDLIFE SERVICE

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IN REPLY REFER TO:

COE-HC

November 24, 1998

District Engineer
Corps of Engineers, San Francisco District
ATTN: Chief, Environmental Planning Section (Peter LaCivita)
333 Market Street
San Francisco, California 94105-2197

Subject: CESF-Napa Salt Marsh Restoration Feasibility Study

Dear Lt. Colonel Grass:

Pursuant to the Scope of Work for 1998, enclosed are three copies of our Planning Aid Report on the Napa Salt Marsh Restoration Feasibility Study. This report has been prepared under the authority of and in accordance with the provisions of Section 2(b) of the Fish and Wildlife Coordination Act (FWCA) (48 stat. 401, as amended; 16 U.S.C. 661 et seq.). This report provides an initial evaluation of the project, including potential benefits and recommendations for phased implementation. More detailed evaluation and additional funding would be necessary to complete coordination activities, including preparation of draft and final FWCA reports.

If you have any questions or desire additional copies of this report, please contact Dr. Steven Schoenberg of my staff at (916) 979-2107.

Sincerely,

Dale A. Pierce
Acting Field Supervisor

Enclosure

cc: FWS, AES, Portland, OR
FWS, San Pablo Bay NWR, Mare Island, CA
CDFG, Yountville, CA
NMFS, Santa Rosa, CA

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

PLANNING AID REPORT
FOR THE

NAPA SALT MARSH RESTORATION FEASIBILITY
STUDY

PREPARED BY:

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PREPARED FOR:

U.S. Army Corps of Engineers
San Francisco District
San Francisco, California

November 1998

INTRODUCTION

The project area encompasses about 9,850 acres of salt ponds and sloughs within Napa Marsh, bounded by the Napa River, Napa Slough, and Dutchman Slough (Figure 1), just north of the San Pablo Bay National Wildlife Refuge and Cullinan Ranch. Though historically a complex of tidal marsh and sloughs, about two-thirds of these marshes were diked and drained for hay production around the turn of the century, while about 3,500 acres of remnant tidal sloughs and wetlands remain. From 1954 to 1990, about 6,370 acres were used for salt production in which salt water was taken in from San Pablo Bay (North Bay) into the ponds closest to this bay, evaporated, and the brine moved through a system of powered and gravity-fed pumps to successively more concentrated ponds. The salts were eventually harvested in crystallizers on the east side of the Napa River. Salt production ceased after the company lost its sole customer for salt, and in 1994 the site was purchased through settlement funds from a 1988 oil spill at a refinery in Martinez. The goal of the settlement fund was to create or restore wetlands to compensate for impacts of the oil spill. The ownership of the project area was transferred to the State of California.

The original diking and internal levees created for the former salt production divides the project area into eleven 2-4-foot deep "ponds" denoted by number (Ponds 1, 1A, 2, 2A, 3, 4, 5, 6, 7, 7A, and 8), in which the salinity varied with pond number up to 200 parts per thousand (6X salt water) as the salts were concentrated by evaporation and eventually precipitated out for harvesting (Figure 1). Pond 2A was returned to tidal action by breaching of the levee in 1995, and has since rapidly established marsh vegetation. Of the others, Ponds 7, 7a and 8 are considered "bittern" ponds, in that they have very high dissolved concentrations and precipitates of unharvested magnesium and calcium salts. Since idling of salt production, salinities have remained low in Ponds 1, 1A, and 2, but are higher in Ponds 3, 4, 5, 6, and 6A, in some cases increasing since salt production has ceased. Because the State does not have funds to maintain the pumps, water conveyance system, and levees, these residual salts pose some risk to water quality in the ponds themselves, as well as to that in adjacent sloughs, nearby mudflats and tidal marshes, and the Napa River, particularly in the event of uncontrolled release during a levee failure.

The feasibility study examines ways in which portions or all of the project area could be restored to tidal action and/or better managed to the benefit of fish and wildlife resources. Major issues to be considered are means to remove the excess salt in most ponds, and phasing the restoration in a way that minimizes impacts (i.e., on resources which use the project area in its current state), as well as maximizes benefits of a conversion to tidal action.

This Planning Aid Report has been prepared under the scope of work for the 1998 fiscal year. The purposes of this report are to describe biological resources in the area, discuss environmental constraints, regional habitat needs and restoration objectives in the study area, indicate areas and resources of particular ecological sensitivity, provide recommendations for fish and wildlife studies to be performed during the feasibility phase, and provide a cost estimate for a habitat evaluation (Attachment A). No previous Fish and Wildlife Service

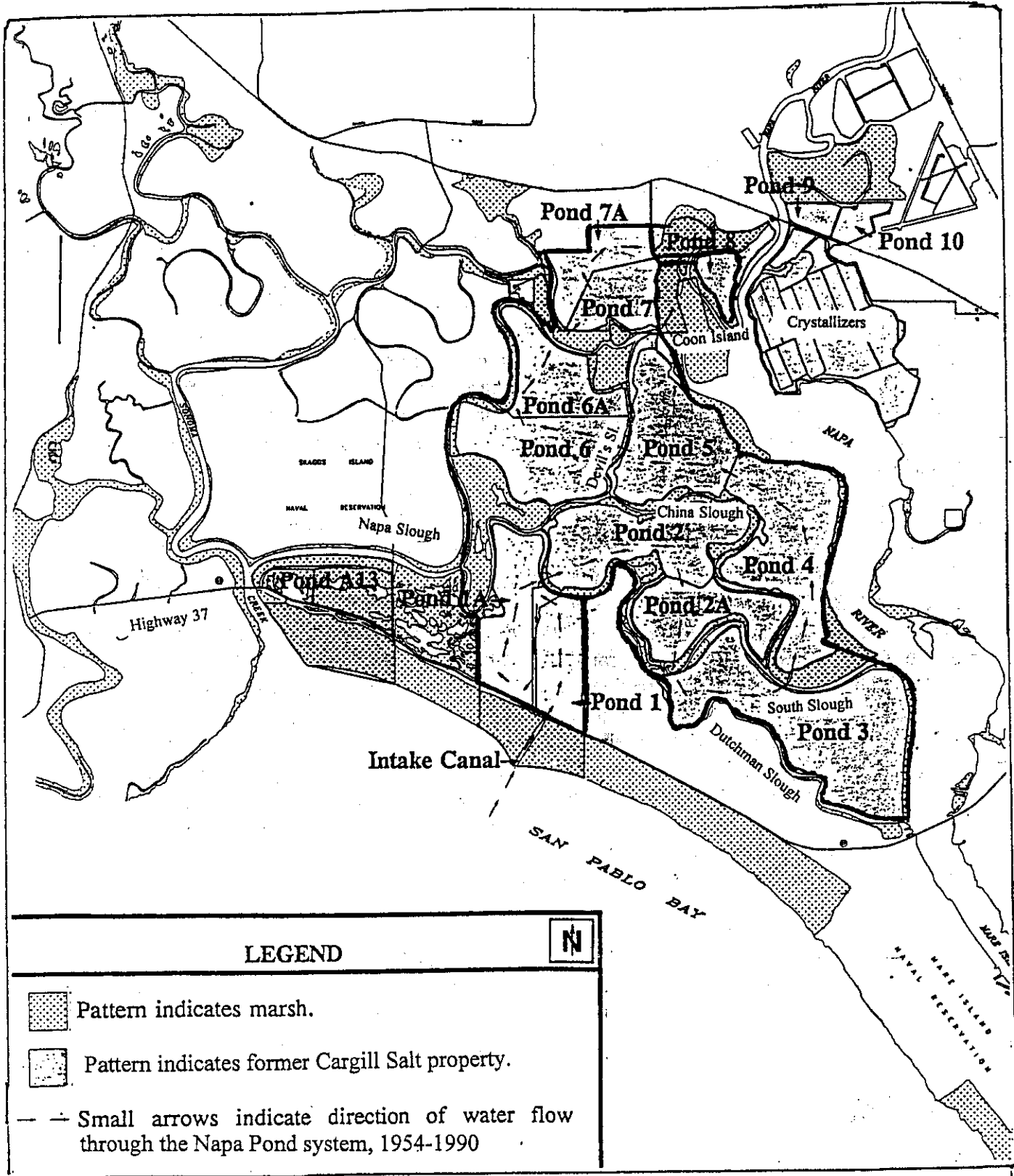


Figure 1. Napa River salt marsh restoration feasibility study area (thick outline).

(Service) documents have been prepared for the proposed restoration. However, the site had been considered in several permit actions submitted by the former salt production facility, included in our comments on an overall goals document issued by the San Francisco Estuary Project (SFEP 1998), and evaluated in developing recovery plans for several federally-listed species. The Service also participated in the Shell Oil Spill Litigation Settlement Trustee Committee, which was involved in the purchase of the site.

BIOLOGICAL RESOURCES

The habitat cover-types present in the project area are: open water tidal slough, tidal emergent marsh, muted tidal marsh, salt pond, and upland. The biological resources of the study area have been described by original data and reviews of past records in PWA (1997), Lewis and WRA (1992), and Madrone (1977). In addition, several years of waterfowl survey data at various locations throughout the San Francisco Bay area (including surveys of the salt ponds) were analyzed by Accurso (1992), and annual winter aerial surveys have since been conducted by the Service, although these most recent data were not reviewed in the preparation of this report.

Vegetation - Tidal emergent marsh is well established along much of the border of the tidal sloughs, and has rapidly colonized Pond 2A with pioneer species since breaching of its levees in 1995. To our knowledge, there are no site-specific surveys available for Napa Marsh other than Pond 2a, but vegetation would be expected to vary considerably with location and between years. At the time the site was visited by Service staff, the marsh appeared to be typical of brackish marshes throughout the North Bay. The plants we observed were predominantly rushes and brass buttons in the marsh areas, consistent with recent surveys conducted in Pond 2A (PWA 1997). Other than Pond 2A, and some scattered pickleweed on the interior of the levees, the other salt ponds did not appear to support rooted vegetation, although some of them currently exhibit high algal production, and associated forage like brine shrimp, brine flies, and sometimes salt-tolerant fish species. Upland vegetation consists of some sections of levees planted with iceplant, but were otherwise vegetated with common upland herbaceous species such as yellow star thistle, and occasional coyote bush.

As a general pattern, the main marsh plant species are pickleweed, saltgrass, and fat-hen in higher salinity areas of high marsh (i.e., closer to the bay edge), cordgrass in higher salinity areas of low marsh, and cattails in areas of lower salinity (i.e., more inland from the bay edge). However, the vegetation varies with the long-term hydrologic regime, with the more saline assemblage expanding in extent after several consecutive dry years, and the brackish and even freshwater species becoming more prominent after several consecutive wet years.

Fisheries - The tidal and non-tidal waters of the project area are important for a variety of estuarine fish species. The study area was examined for three years in the early 1970s by Madrone (1977), in summer 1991 by Lewis and WRA (1992) after salt production had ceased but before the ponds were transferred to the State, and in Pond 2A since the 1995 breaching

(PWA 1997). In the 1970s, the most abundant species were striped bass, Pacific staghorn sculpin, Sacramento splittail, and yellowfin goby in the summer, tule perch in the winter, and delta smelt in the spring (Madrone 1977). Thirteen species were collected in 1991 in the salt ponds, of which the following 5 species were represented by all life stages and concluded to have been breeding there: rainwater killifish, topsmelt, yellowfin goby, longjaw mudsucker, and threespine stickleback. Of these, rainwater killifish, topsmelt and yellowfin goby accounted for 95 percent of all fishes collected. Several other species were found as juveniles only: shiner surfperch and walleye surfperch, striped bass, white croaker, and inland silverside. Neither Delta smelt nor Sacramento splittail were present in the ponds in 1991. In the baseline study of Pond 2A, PWA (1997) found large numbers of striped bass, Sacramento splittail, topsmelt, and yellowfin goby, as well as abundant inland silversides, northern anchovy, American shad, and a small complement of longjawed mudsucker. Although not indicated in the sampling reviewed in this report, the tidal sloughs almost certainly receive some use by juvenile steelhead trout during their outmigration to the Pacific Ocean.

Birds - Both the tidal marshes and salt ponds receive considerable bird use, due to sheltered conditions and abundant food. The outboard marsh areas support an abundant invertebrate forage which feed on marsh detritus. Several of the salt ponds are also very productive, mainly due to the brine shrimp and brine flies which live on phytoplankton and benthic algae. During the waterfowl migration season, the salt ponds are most heavily used by diving ducks for rafting, particularly the canvasback, scaup, and ruddy duck. For example, during the Service's annual winter waterfowl survey in 1989, about 75 percent of all canvasbacks in the San Francisco Bay area were seen in these particular salt ponds (Accurso 1992). Similarly, a 1975-76 ground survey recorded about two-thirds of the canvasbacks in the few North Bay salt pond stations studied (Madrone 1977). It has been postulated that the large unbroken water area in combination with moderately elevated salinity attracts these canvasbacks. The canvasbacks have been observed feeding as well as rafting. Dabbling ducks are also present in the ponds, particularly wigeon, shoveler, pintail, gadwall, and teals, although these are much less abundant here than in the South Bay salt ponds. The dabblers are also known to nest on the vegetated levees in the project area. Ponds 1-5 tend to have the greatest abundance of all ducks, with much lower abundances in Ponds 6 and 7, and almost no use in Pond 8 (FWS, unpublished data). In addition to ducks, American coots and eared grebes are much more common in these salt ponds than elsewhere in San Francisco Bay.

A variety of wading and shore bird species may be expected to use the ponds during the migratory season, such as black-bellied plover, marbled godwit, western and least sandpiper, dunlin, dowitcher, snowy egret, common egret, Wilson's phalarope, northern phalarope and great blue heron. Use of the site varies with species. Many shorebird species move during the day, using the mudflats at low tide, but shift to the salt ponds at high tide as supplemental feeding and/or roosting habitat. Some species like snowy plovers, black-necked stilts and American avocets use the ponds throughout the day, sometimes nesting on internal pond levees. The phalaropes and stilts as well as the grebes prefer higher salinity ponds, fish-eaters like the pelicans and cormorants congregate in ponds with low salinities, while the shorebirds and nesting terns show no marked salinity preference (Harvey et al. 1992).

A number of sea birds are also known to use the salt ponds, such as white pelicans, occasional brown pelicans, double-crested cormorants, as well as abundant gulls and terns, several of which nest on the levees, small islands within the ponds, or windrow snags. One survey (Carter et al. 1990, as cited in Lewis and WRA 1992) documented about 200 nests each of the cormorant and Forster's terns, in addition to 38 Caspian tern nests, and 4 western gull nests.

A variety of land birds occur within the project area, primarily in the marshes outboard of the pond levees. These include fairly abundant species such as redwinged blackbirds, marsh wrens, savannah sparrows, various finches and swallows, as well as the less common local species such as the salt marsh yellowthroat, San Pablo song sparrow, black rail and the endangered California clapper rail (discussed below). White-tailed kites and northern harriers have been observed in the marshes, as well as the salt ponds (Madrone 1977).

Mammals - The project area supports at least 22 known mammal species, including the endangered salt marsh harvest mouse. Other more common species include the muskrat, racoon, brush rabbit, black-tailed jackrabbit, striped skunk, Norway rat, house mouse, California vole, and longtail weasel (Madrone 1977). These species inhabit the higher marsh areas of the project area.

Endangered Species - Endangered and threatened species that may occur in or be affected by the project are listed in Attachment B. The salt marsh harvest mouse and California clapper rail have both been recorded in the study area, although their distribution has been limited and the populations fluctuate with year-to-year changes in hydrologic regime. Salt marsh harvest mice have been seen in 4 locations (Lewis and WRA 1992): Coon Island (near Pond 8), South Slough (bordering Pond 3), all along the marshes bordering San Pablo Bay (near Ponds 1 and 1a), and at the mouth of Sonoma Creek (within 2 miles of Pond 1). The preferred habitat of the mouse is high marsh, mainly composed of pickleweed, together with some component of upland refugia from high tides. The mouse may be present in the narrow strips of tidal marsh surrounding the salt pond levees.

The California clapper rail is also known from at least 4 locations from the project area: Dutchman Slough (bordering Pond 3), all along Napa Slough (the west border of the study site), the mouth of Sonoma Creek, and Devil's Slough (the east border of Ponds 6 and 6a). This species is associated with salt and brackish coastal marshes dominated by cordgrass with other halophytes like pickleweed. Clapper rails in Napa Marsh are also seen in brackish marsh vegetation like tules and baltic rush. As with the salt marsh harvest mouse, the clapper rail needs a component of upland refugia at high tide.

Western snowy plover has been reported nesting in small numbers in the vicinity of Ponds 6 and 6a in 1975 (Lewis and WRA 1992), and a few are still seen today (personal communication from Tom Huffman, California Department of Fish and Game), as are a few brown pelicans. Among listed plants, soft bird's beak is present in several nearby locations, but not within the study area.

REGIONAL HABITAT NEEDS

Because of its wide array of fish and wildlife, San Francisco Bay has many different habitat needs. Increasing the area of tidal marshland would benefit a wide array of organisms: resident birds such as the salt marsh yellowthroat, San Pablo song sparrow, and marsh wren, some waterfowl species, native estuarine fishes, and juvenile anadromous fishes. Establishing large, contiguous blocks of tidal marsh habitat is needed to maintain viable populations of these more common species, as well as the listed species such as the delta smelt, California clapper rail, and salt marsh harvest mouse. Tidal marshes need to be restored in such a way that they are hydrodynamically self-sustaining, involving a minimum amount of maintenance and oversight. Tidal marshes also serve as a source of nutrients and detritus which support the planktonic and benthic communities of the open water communities of the river estuaries and the bays, and the fish and wildlife which rely on them as forage.

Throughout the San Francisco Bay estuary, many important aquatic species vary in response to organic and nutrient input, and freshwater inflows (Herbold et al. 1992). San Pablo Bay in particular is believed to be a very important nursery ground for commercially important species such as flatfish and striped bass, as well as for forage species like the northern anchovy. Although San Pablo Bay is believed to obtain about 20 percent of its carbon influx from the export of tidal marsh detritus, its position renders this bay somewhat sensitive to low Sacramento-San Joaquin Delta outflows. During high outflows, the entrapment zone is pushed across the broad shallows of San Pablo Bay, increasing phytoplankton abundances both due to entrapment processes as well as by limiting the extent of the asiatic clam (Herbold et al. 1992). On the other hand, low outflow results in reduced phytoplankton abundance, elevating the importance of allocthonous carbon derived from marshes. The proposed restoration would provide much of this important marsh habitat and its associated ecosystem function, thereby buffering the estuary from fluctuations in outflow.

However, not all organisms in the region may benefit from a tidal marsh restoration project. As described above, some waterfowl species and shorebirds rely on open water habitat such as that currently provided by the salt ponds in both the North and South Bays. Since the proposed project would increase tidal marsh at the expense of open water habitat, another habitat need might be to provide for these species, either by improving management of remaining open water areas, or replacing some of this habitat over the long term through restoration of other diked baylands. This may be important for certain species like the canvasback duck which has experienced long term population decline even when the project area was maintained in salt production. This management may occur within the project area and in association with the project, but could also be done regionally in other areas of the North Bay independent of the project. At a minimum, the responses of these species should be carefully monitored during the early phases of tidal marsh restoration to determine whether additional actions are needed to preserve population stability.

The SFEP (1998) developed draft goals for each of San Francisco Bay's subregions, including the North Bay. Several of the key ecological objectives identified in SFEP (1998) are relevant to the subject project, namely, to restore tidal marsh patches that would be large enough to support sustainable populations of special status species, to replace tidal marshes at bay edges and mouths of stream and river courses, and to establish managed saline ponds close to mudflats to provide high-tide shorebird habitat. In addition, the SFEP (1998) approximated a bayland habitat distribution for the future, which would greatly increase the extent and proportion of tidal marsh, partially at the expense of salt ponds, while replacing salt pond functions with a smaller area of managed saline ponds. Near, but not within the study area, SFEP (1998) recommended that Cullinan Ranch and portions of Skaggs Island be restored to tidal marsh, and that the east side crystalizers, across the Napa River, be managed as saline pond habitat.

In our September 23, 1998, comments on SFEP (1998), we also emphasized the need for research on how salt ponds could be enhanced to function with the maximum habitat benefit, and least maintenance cost. We further stated that any concurrence with the SFEP document would be deferred pending the completion of recovery plans for listed species, whose status commands that recovery actions take precedence over less specific, estuary-wide goals.

SENSITIVE RESOURCES

Several fish species would be considered sensitive, in that they would be especially benefitted by the project. The delta smelt is the only obligate estuarine species, whose distribution has been greatly confined by reclamation and channelization projects in the Sacramento-San Joaquin Delta and project area. The proposed project would likely provide a large increase in available habitat for this species, especially in the form of blind sloughs preferred by the delta smelt for spawning. Also, the striped bass would be sensitive by virtue of the known correlation of striped bass larval survival to available food (Herbold et al. 1992). Although stripers are most commonly associated with open waters, they do congregate and forage around marsh-slough interfaces and near levee breaches such as would be created by the proposed project. The export of detritus from the marsh to surrounding bays should enhance productivity in the open waters, benefitting striped bass as well as other species.

Certain bird species which exhibit strong affinities to the project area, such as diving ducks generally, the canvasback duck in particular, and several shorebirds such as the avocet and blacknecked stilt, may be impacted by a tidal restoration of the project area. Synoptic surveys of the San Francisco Bay area suggest that waterfowl which use of the North Bay salt ponds do not do so exclusively (Accurso 1992). Ruddy ducks congregate and forage in salt ponds of both the North and South Bays. Canvasbacks concentrate in the North Bay salt ponds, and to lesser degrees at the mouth of the Petaluma River, Suisun Marsh, and in the South Bay salt ponds. Shovelers use Ponds 1 and 1a, muted tidal areas which may not be subject to alteration by the restoration project. If the salt ponds were restored to marsh, some diving ducks and other birds might move to these other areas, where they may encounter less

desireable forage or resting conditions. It is also possible that the waterfowl which use the North Bay, like some shorebirds, represent a genetically distinct population segment of those species.

Prairie ducks like the canvasback are winter residents in San Francisco Bay, arriving from breeding areas in central and western Canada and Alaska. While not listed, the canvasback population has undergone several serious declines in the 20th century, most often associated with losses of breeding area quality resulting from drought, the agricultural conversion of their preferred celery-grass wetlands that occurred in association with prairie potholes, and in part, to overhunting of the females. Habitat quality of the breeding grounds is conventionally considered most important to population stability, because it is there that the ducks must meet the bulk of their dietary demands, and competition with other species and habitat reduction would be expected to have a major effect on population trends. Nevertheless, wintering habitat must be sufficient to at least sustain the migrants in good condition.

While it is clear that the North Bay salt ponds attract the greatest concentrations of canvasback, it is difficult to predict what effect their conversion to tidal marsh would have on the canvasback population. The population might redistribute to other areas, but it is unknown whether or not this would result in such a reduction in body condition that the birds would subsequently experience mortality or reduced reproductive success. Such responses cannot be easily assessed at present, and would involve assessments of the foraging behavior, movement, and condition of ducks which use this site and other areas, studies that are beyond the scope of the proposed project. One approach would be to implement the restoration gradually, so that the responses of these species can be monitored and subsequent restoration phases adjusted to their needs. Ideally, regional planning would take a conservative approach, seeking to preserve the habitat functions and values for diving ducks within the North Bay, preferably within the project area.

The outboard marsh areas would be considered areas of sensitivity which might be affected by tidal restoration. This is so because of the presence of the listed California clapper rail and salt marsh harvest mouse along these sloughs, as well as the rare, but not listed black rail, salt marsh yellowthroat and San Pablo song sparrow in this same habitat. These areas are likely to be diminished initially, due to the large anticipated increase in tidal prism that would cause the major sloughs dividing the islands to widen and erode the marsh. This impact might be compensated over time as tidal marsh re-established within the islands.

Several locations near the study area would also be considered of high ecological sensitivity because of existing populations of listed species, including Coon Island, and the band of salt marsh south of Highway 37. Coon Island is referred to as a natural area whose plant associations reflect its salinity intermediate between Petaluma Marsh to the west and Suisun Marsh to the east (Madrone 1977). A tidal restoration would not have any anticipated impacts on these areas, except in the event of an uncontrolled release of bittern.

RESTORATION OBJECTIVES

At this time, alternative plans for the restoration of Napa Marsh have not been specified. It is our recommendation that the restoration objectives be: a) to increase tidal marsh habitat, and in a sequence which maximally benefits listed species using this habitat; b) to reserve a portion of the project area for waterfowl and shorebirds; and c) to institute specific "common" elements of all reasonable restoration permutations early, so as to provide a basis for adaptive management and adjustment of the remainder of the site. These elements would not include portions of the project area which would require longer remediation or would be decided later based on the outcome of earlier phases.

The study area can be sub-divided into roughly four categories determined on the basis of the current management and ultimate restoration objective. First, there would be areas which will be managed in their present state. Ponds 1, 1a and 2a fall in this category. Currently, Ponds 1 and 1a are essentially operated as muted marshes by virtue of a controlled intake channel from San Pablo Bay which had also served as an intake for the former salt production facility. The existing levees are easily accessed by road. These ponds already provide relatively good values as forage areas for dabbling and diving ducks. In addition, opening these ponds to full tidal action may require a levee between the ponds and Highway 37 to prevent exposure of the road to tidal flooding (Corps 1997). Leaving these ponds in their present form would maintain some waterfowl habitat during restoration and preclude flooding problems. Pond 2a, while not at equilibrium, has already been opened to tidal action and is already vegetated.

The second category includes those ponds which would be eventual candidates for tidal marsh restoration, but currently have elevated salinities which would need to be reduced before returning them to full tidal action. One or more such ponds might be needed in the near term for receiving diluted bittern water for an extended period. Pond 6a seems the most likely candidate for such a purpose, because it is closest to the bittern ponds, but this operation may involve other ponds close to the bittern area (i.e., Ponds 5 and 6), especially if a brine source was desired to reduce toxicity of the bittern (see below).

The bittern ponds (Ponds 7, 7a, and 8) represent a third category whose chemistry would require long term remediation prior to any restoration. They are more inland from San Pablo Bay and its contiguous marsh parcel, which could subject them to more freshwater influence and result in less persistent habitat for salt marsh-associated listed species than other areas. Under the scenario presented in the reconnaissance report (Corps 1997), and recommended by SFEP (1998), these ponds would at some later point be restored to managed saline ponds.

The remaining Ponds 2, 3, and 4 comprise a category which, by virtue of their specific location in the site and absence of other likely uses, would be candidates for early restoration. In addition, their relatively bayward location would foster more persistent saline vegetation, and their large size combined with Cullinan Ranch would form an unbroken, contiguous block of marsh habitat desired for maintaining populations of listed species. The position of Ponds 3 and 4 next to the Napa River suggests that they would readily accrete sediment, and provide

additional values to estuarine fishes. The planned restoration of Cullinan Ranch will widen Dutchman Slough, affecting the integrity of Pond 3's levees in any case. Pond 2 might be excluded from association with bittern disposal in any case, because the siphon transfer system has already been interrupted by the breaching of Pond 2a, and would require additional infrastructure to replace.

ENVIRONMENTAL CONSTRAINTS

Environmental constraints, factors which limit the implementation of restoration, are: a) removal of salt and bittern, which would delay restoration of these ponds and other ponds needed for dilution; b) the need to preserve to some extent, the existing values of the salt ponds to waterfowl and shorebirds; in doing so, such areas are removed as candidates for the tidal restoration objective; c) consideration of the erosional effect of increased tidal prism on marsh habitat in the major sloughs or on the integrity of the levees themselves; and d) consideration of rates of sedimentation and effects on the course of restoration. The specific need to conserve and recover listed species associated with tidal marsh habitats is considered a promoting and guiding factor, rather than one which limits restoration.

Salt and Bittern Removal: Except for Ponds 1, 1a, 2, 2a, and 3, the remaining ponds have elevated levels of salt which would need to be reduced before returning the ponds to full tidal action. The Corps' reconnaissance report suggested that Ponds 4, 5, 6, and 6A be managed using water control structures and weirs, allowing the ponds to receive fresh water during flood events, and release the diluted salt during low tides. The Corps (1997) mentions that other, lower salinity ponds (presumably Ponds 2 and 3), may be needed as basins for further diluting the salt from the higher salinity ponds.

Ponds 7, 7a, and 8 have very high concentrations of magnesium and other salts (bittern) in solution and deposited as precipitate after the sodium chloride was crystallized out, which limit the habitat quality. Early on, one concept discussed was to "reverse" the salt pond system, and discharge the excess salts in a diluted form into San Pablo Bay. However, this concept has a number of problems, namely: a) investment in maintaining, and possibly amending the existing pond and pump system and levees for an indefinite period; b) effects of the released salts on relatively good quality muted tidal habitat in Ponds 1 and 1a; and c) precluding tidal restoration of any of the involved ponds until the salts are eliminated. These factors argue against the "reversal" concept as a means of restoring these ponds.

A second concept which has been under consideration is to dilute the bittern with Napa River estuary water, and discharge it either back into the Napa River, or pipe it to San Pablo Bay. Studies thus far indicate that this bittern needs to achieve a dilution of at least 1:100 to eliminate acute and chronic toxicity (Hansen 1994). One estimate is that about 5 years would be needed to discharge the bittern and another 3 years to redissolve and dispose the residues (Rugg 1994), although it could take considerably longer. The same estimate noted that this dilution would represent a discharge (and intake) of 100 cubic feet per second of diluent

water. The extent to which other ponds might be involved, to mix and dilute the bittern, would depend on the desired rate of removal, when the dilution water is taken in and in what volume. At least one pond would seem to be required, presumably Pond 6A, which is nearest to the bittern ponds. If mixing could be enhanced at the discharge point, then more concentrated effluent could be stored and released, and the area needed to store diluted bittern and time to dispose of it could be reduced.

Ponds 1, 1a, and 2 would be inappropriate for receiving diluted bittern water ^{not true!} ~~not only because the transfer system has been interrupted by the restoration of Pond 2a, but also~~ because the water quality of these ponds and habitat values provided are relatively high. Pond 3 would be less likely to be considered for diluted bittern water because of its current, higher wildlife use and more moderate salinities, which support of fish and other forage organisms. Pond 3's position along the river nearest to the mouth suggest that it would more readily accrete sediment, and its location next to Cullinan Ranch would enlarge the contiguous marsh habitat, making it a higher priority site for early restoration.

The use of Napa River estuary water to dilute the bittern would probably involve a weir structure that would allow water to be taken in unscreened. As this occurs, there could be impacts to fishes which enter the bittern disposal system with the dilution water. Certain species may be able to tolerate the mixture and serve as forage for wildlife. Most species would not survive or complete their life cycle, such as salmonids and delta smelt. It may be possible to regulate the timing of intake so that impacts to these species are minimized.

A third way that salt could be eliminated would be by mixing it with treated wastewater, which would avoid the impact on fishes of using estuary water. Additional information that needs to be developed would include estimates of the rates (in cfs) of availability of treated water as well as the the cost and siting of new pipeline and pump facilities.

A fourth way that the salt might be eliminated is by piping it to the Carquinez Straits. Due to the cost of such an operation it is likely that it would not be diluted for this option, and may not be necessary due to the much higher energies and mixing at the point of release in the Straits than at a release point in the Napa River.

A modification of any of the above means might include mixing of the bittern with the brine, in an effort to reduce toxicity by rebalancing the ionic composition. This would involve at least two ponds; one for supplying brine, and another for diluting the bittern-brine mixture. However, this could reduce the amount of dilution water and time needed for disposal.

A fifth way salt could be disposed is by allowing the brine to dry completely, excavating the soils, and disposing of them at an appropriate site.

Preservation or Replacement of existing values -- One issue with the proposed project is that a large-scale conversion to tidal marsh, while benefitting both estuarine fish and marsh-associated wildlife, could impact the wintering population of waterfowl, including the

canvasback ducks and shorebirds which depend on relatively open waters for rafting and/or foraging. As previously mentioned, a phased approach to the restoration would allow a better assessment of the responses of these species to partial conversion of the site to tidal marsh. If it is demonstrated that use of the restored habitats does not decrease conditions for birds using that habitat, and adverse impacts on estuary-wide populations of ducks and shorebirds are low or insignificant, it may not be necessary to institute compensatory actions. But if such effects do occur, various means, both in the remaining phases of this project as well as several outside the scope of the proposed project, could replace habitat or values for the species which use the existing ponds. Several examples are listed below.

Managed Saline Ponds: This would involve a simplified muted tidal operation much like that currently employed in Ponds 1 and 1a; a weir would allow salt or brackish water in during high tides or the flood season, which is allowed to concentrate mildly over the summer, then be released as desired through one or more tidegates. Candidate sites would be those with sturdy levees that would need minimal long term maintenance. Potential areas which could be managed for enhanced shorebird values could include the bittern ponds in the long term (Ponds 7, 7a, and 8), the crystallizers on the east side of the Napa River, and possibly Ponds 6 and 6a.

Hamilton Airfield: This site is under separate study for restoration of its former diked areas, now mostly grassland and concrete grassland, to tidal marsh in conjunction with disposal of dredged material. Portions of the site may provide expanses of sheltered open water and/or mudflat until such time that sedimentation and revegetation have occurred.

Hayfield Conversion: Other areas in the North Bay, currently in hay and oat cultivation, could potentially be managed as ponds.

Increased Tidal Prism -- With tidal restoration, the amount of water exchanged will greatly increase in volume over the tidal cycle. This may result in changes in the morphology of the major sloughs which in many locations support a significant border of marsh vegetation on the outboard side of the levee. As it concerns phased restoration, the Cullinan Ranch restoration will no doubt result in a widening of Dutchman Slough in the near term, possibly to the point that the integrity of levees for adjacent Pond 3 will be compromised. This provides a further rationale for restoring Pond 3 to tidal action as soon as possible, so that controlled breaching will favor formation of tidal channels in the desired locations.

Rates of Sedimentation -- Because the sites are mildly subsided, sediment supply and deposition will have some effect on habitat values, affecting the rate at which the sites ultimately reach equilibrium. Those areas next to the Napa River (Ponds 3, 4, and 5) should accrete sediment faster than other, more inland ponds, ultimately providing the most immediate values for listed marsh species. But those which accrete sediment more slowly may, however, provide longer interim values to diving ducks.

RECOMMENDATIONS

We recommend the Corps of Engineers:

1. Proceed with planning for restoration in phases, with accelerated implementation of a "first phase" restoration of those ponds where there is general agreement among cooperating agencies that the action does not conflict with any other management scenario, that such restoration would have the greatest and most immediate benefit to listed species, and that it would moderate ongoing degradation in water quality of those areas. In order of decreasing priority, this recommended first phase would consist of two independent sub-phases: a) returning to full tidal action of at least one of two ponds with low-to-moderate salinity (Ponds 2 and 3); Pond 3 being given the highest priority because of its location next to the Napa River; b) implementing salinity reduction in at least one of three ponds with elevated salinity (Ponds 3, 4, and 5); Pond 4 being given highest priority also because of its location next to the Napa River.
2. Restoration of other areas should be planned in subsequent phases, acknowledging potential alternate use or delayed restoration in other ponds as follows:
 - (a) Ponds 1 and 1a: these ponds currently are of high value and may continue to be operated as muted tidal marshes;
 - (b) Pond 2a: this pond has already been opened to tidal action and no management or further modification is recommended at this time;
 - (c) Ponds 5, 6: these ponds have elevated salinities which need to be reduced prior to restoration, and one or both of these ponds may be needed as a source of brine to mix with bittern, or to receive and dilute bittern water;
 - (d) Pond 6a: this pond also has elevated salinity, and is more likely to be involved in eventual bittern disposal because it is closest to the bittern ponds;
 - (e) Ponds 7, 7a, and 8: these ponds are likely to be very long term candidates for ultimate management as managed saline ponds, because of the need for time to dispose of bittern present in these ponds.
3. Exclude from consideration any management scheme for salinity reduction in Ponds 4, 5, 6, and 6a, which would involve ponds with low salinity for dilution that have either existing high values (i.e., Ponds 1, 1a), or ponds recommended for first phase restoration (Ponds 2 and 3).
4. Design increase roosting and nesting habitat for shorebirds by making levee slopes flatter on restored ponds.

5. Locate levee breaches in the vicinity of historic major channels.
6. Prior to breaching of levees, block interior channels, so as to promote major tidal flows through the interior of the site.
 (ditches adjacent to levees)

FISH AND WILDLIFE STUDY NEEDS

1. Since salt production has ceased, several of the ponds have increased in salinity, which may be affecting baseline habitat values. Wildlife censusing and fish sampling should be done to determine if there has been any significant change in use by waterfowl and shorebirds or available forage.
2. The conversion of much of the pond area to marsh may result in a temporal loss of habitat quality for some species which use open shallow water. A concept presented by the SFEP (1998) is to have managed saline ponds which would have more values in a smaller area than salt ponds. Potential measures could include optimizing and stabilizing salinity of such managed ponds for forage items such as brine shrimp and brine flies and creating small roosting islands. Conceptual designs need to be developed and other studies completed to examine the feasibility, and cost, of this concept.
3. While diving ducks are known to heavily use many of the salt ponds, such areas did not occur historically, suggesting that the birds may possess evolved behavioral adaptations for wintering in San Francisco Bay in the absence of large areas of enclosed open water. Studies should be completed, or reviews of available information performed, to assess the foraging efficiency, diet, post-winter condition, and movements of waterfowl which use the salt ponds, compared to other areas in South Bay salt ponds, and San Pablo and Suisun Bays.
4. Reference sites need to be selected and monitored as a baseline to which habitat types restored or affected by the restoration can be compared. These should include one or more of the following: unrestored salt pond habitat, natural marsh (and minor slough) habitat, and unimpacted major slough habitat. Baseline biological (and physical) monitoring should be initiated in these areas.
5. A streamlined, cost-effective monitoring program needs to be developed to generally characterize habitat development and fishery and wildlife use of reference, unrestored areas, and restored areas. Elements of such a program should include: a) physical characteristics - to determine deposition of sediments and/or changes in major slough morphology; b) vegetative cover; c) fish use - categorize types of microhabitat (e.g., minor sloughs, edge vegetation, position with respect levee breach etc.) and define sampling methods; d) wildlife; and e) invertebrate forage.

6. Measures to provide alternative habitat for some duck and shorebird species potentially adversely affected by restoration need to be evaluated. Candidates might include:
 - a) transitional shallow open water created as a part of the Hamilton Airfield restoration project;
 - b) purchase and operation of the crystallizers as shorebird/waterfowl habitat, on the east side of the Napa River; and
 - c) managing some ponds within the study area as muted tidal or managed saline ponds.

7. Soil analyses should be conducted and the results evaluated for the potential effect on marshplant re-establishment.

8. Testing should be done to determine the extent to which bittern toxicity, and the requirement for dilution, are affected by combining bittern with brine.

9. Periodic monitoring of selenium and mercury in sediment and biota should be conducted to evaluate the potential impacts of these contaminants on restored wetlands.

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ATTACHMENT A: FISH AND WILDLIFE COORDINATION ACT COSTS

The cost and time needed for quantifying changes in habitat value with the project using Habitat Evaluation Procedures (HEP), if one is desired, would depend on the size and habitat heterogeneity of the site, number of cover-types, complexity of the futures analysis, and availability of models suitable for assessing the functions and values of the existing and future habitats to be restored. In the project area, the existing salt ponds and any future managed saline ponds would function primarily to provide winter migration values to both waterfowl and shorebirds, whereas the restored tidal marshes would provide values to both native fishes and special status species. However, many of the HEP library models consider variables that do not accurately reflect the nature of the salt ponds or seasonal use, and no models have yet been developed for California native estuarine fishes. It would likely be necessary to develop alternative models, or employ modified analyses (such as the Corps' WET or Wetland Evaluation Technique) in order to reasonably estimate future habitat values of a restoration plan. The minimum budget would be as follows:

model review and development	10 BDs	31 days X \$750 ¹ per BD = ~\$23,250
reference site selection and evaluation	5 BDs	
existing conditions evaluation	3 BDs	
alternative formulation	3 BDs	
futures analysis (assuming 3 increments)	10 BDs	

Draft and final Fish and Wildlife Coordination Act reports would involve presentation of the HEP, additional coordination with Service staffs involved with refuges and endangered species recovery planning, and more specific recommendations within the scope of the project. We estimate about 22 Biologist Days for both reports (\$16,500), in addition to funding of the HEP study.

¹FY 99 Biologist Day (BD) cost



ATTACHMENT B

Endangered and Threatened Species that May Occur in
or be Affected by Projects in the Following Selected Quads

September 16, 1998

QUAD : 483A CUTTINGS WHARF

Listed Species

Mammals

salt marsh harvest mouse, *Reithrodontomys raviventris* (E)

Birds

American peregrine falcon, *Falco peregrinus anatum* (E)

California brown pelican, *Pelecanus occidentalis californicus* (E)

California clapper rail, *Rallus longirostris obsoletus* (E)

western snowy plover, *Charadrius alexandrinus nivosus* (T)

bald eagle, *Haliaeetus leucocephalus* (T)

northern spotted owl, *Strix occidentalis caurina* (T)

Amphibians

California red-legged frog, *Rana aurora draytonii* (T)

Fish

tidewater goby, *Eucyclogobius newberryi* (E)

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

winter-run chinook salmon critical habitat, *Oncorhynchus tshawytscha* (E)

delta smelt, *Hypomesus transpacificus* (T)

coho salmon - central CA coast, *Oncorhynchus kisutch* (T)

Central California steelhead, *Oncorhynchus mykiss* (T)

Invertebrates

callippe silverspot butterfly, *Speyeria callippe callippe* (E)

California freshwater shrimp, *Syncaris pacifica* (E)

Plants

soft bird's-beak, *Cordylanthus mollis ssp. mollis* (E)

Contra Costa goldfields, *Lasthenia conjugens* (E)

QUAD : 483A CUTTINGS WHARF

Proposed Species

Fish

Central Valley spring-run chinook salmon, *Oncorhynchus tshawytscha* (PE)

Central Valley fall-run chinook crit hab, *Oncorhynchus tshawytscha* (PT)

Central Valley fall-run chinook salmon, *Oncorhynchus tshawytscha* (PT)

Sacramento splittail, *Pogonichthys macrolepidotus* (PT)

Candidate Species

Amphibians

California tiger salamander, *Ambystoma californiense* (C)

Species of Concern

Mammals

greater western mastiff-bat, *Eumops perotis californicus* (SC)

long-eared myotis bat, *Myotis evotis* (SC)

fringed myotis bat, *Myotis thysanodes* (SC)

long-legged myotis bat, *Myotis volans* (SC)

Yuma myotis bat, *Myotis yumanensis* (SC)

Pacific western big-eared bat, *Plecotus townsendii townsendii* (SC)

Suisun ornate shrew, *Sorex ornatus sinuosus* (SC)

Birds

tricolored blackbird, *Agelaius tricolor* (SC)

Bell's sage sparrow, *Amphispiza belli belli* (SC)

western burrowing owl, *Athene cunicularia hypugea* (SC)

ferruginous hawk, *Buteo regalis* (SC)

saltmarsh common yellowthroat, *Geothlypis trichas sinuosa* (SC)

San Pablo song sparrow, *Melospiza melodia samuelis* (SC)

Reptiles

northwestern pond turtle, *Clemmys marmorata marmorata* (SC)

California horned lizard, *Phrynosoma coronatum frontale* (SC)

QUAD : 483A CUTTINGS WHARF

Species of Concern

Amphibians

- foothill yellow-legged frog, *Rana boyllii* (SC)
- western spadefoot toad, *Scaphiopus hammondii* (SC)

Fish

- green sturgeon, *Acipenser medirostris* (SC)
- river lamprey, *Lampetra ayresi* (SC)
- Pacific lamprey, *Lampetra tridentata* (SC)
- longfin smelt, *Spirinchus thaleichthys* (SC)

Invertebrates

- Ricksecker's water scavenger beetle, *Hydrochara rickseckeri* (SC)

Plants

- Suisun Marsh aster, *Aster lentus* (SC)
- valley spearscale, *Atriplex joaquiniana* (SC)
- delta tule-pea, *Lathyrus jepsonii* var. *jepsonii* (SC)
- legenere, *Legenere limosa* (SC)
- Mason's lilaeopsis, *Lilaeopsis masonii* (SC)
- Marin knotweed, *Polygonum marinense* (SC)

QUAD : 483B SEARS POINT

Listed Species

Mammals

- salt marsh harvest mouse, *Reithrodontomys raviventris* (E)

Birds

- American peregrine falcon, *Falco peregrinus anatum* (E)
- California brown pelican, *Pelecanus occidentalis californicus* (E)
- California clapper rail, *Rallus longirostris obsoletus* (E)
- western snowy plover, *Charadrius alexandrinus nivosus* (T)
- bald eagle, *Haliaeetus leucocephalus* (T)

QUAD : 483B SEARS POINT

Listed Species

Birds

northern spotted owl, *Strix occidentalis caurina* (T)

Amphibians

California red-legged frog, *Rana aurora draytonii* (T)

Fish

tidewater goby, *Eucyclogobius newberryi* (E)

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

winter-run chinook salmon critical habitat, *Oncorhynchus tshawytscha* (E)

delta smelt, *Hypomesus transpacificus* (T)

coho salmon - central CA coast, *Oncorhynchus kisutch* (T)

Central California steelhead, *Oncorhynchus mykiss* (T)

Invertebrates

California freshwater shrimp, *Syncaris pacifica* (E)

Plants

Baker's stickyseed, *Blennosperma bakeri* (E)

Proposed Species

Fish

Central Valley spring-run chinook salmon, *Oncorhynchus tshawytscha* (PE)

Central Valley fall-run chinook crit hab, *Oncorhynchus tshawytscha* (PT)

Central Valley fall-run chinook salmon, *Oncorhynchus tshawytscha* (PT)

Sacramento splittail, *Pogonichthys macrolepidotus* (PT)

Candidate Species

Amphibians

California tiger salamander, *Ambystoma californiense* (C)

QUAD : 483B SEARS POINT

Species of Concern

Mammals

- greater western mastiff-bat, *Eumops perotis californicus* (SC)
- long-eared myotis bat, *Myotis evotis* (SC)
- fringed myotis bat, *Myotis thysanodes* (SC)
- long-legged myotis bat, *Myotis volans* (SC)
- Yuma myotis bat, *Myotis yumanensis* (SC)
- Pacific western big-eared bat, *Plecotus townsendii townsendii* (SC)
- Suisun ornate shrew, *Sorex ornatus sinuosus* (SC)
- Point Reyes jumping mouse, *Zapus trinotatus orarius* (SC)

Birds

- tricolored blackbird, *Agelaius tricolor* (SC)
- Bell's sage sparrow, *Amphispiza belli belli* (SC)
- western burrowing owl, *Athene cunicularia hypugea* (SC)
- ferruginous hawk, *Buteo regalis* (SC)
- saltmarsh common yellowthroat, *Geothlypis trichas sinuosa* (SC)
- San Pablo song sparrow, *Melospiza melodia samuelis* (SC)

Reptiles

- northwestern pond turtle, *Clemmys marmorata marmorata* (SC)
- California horned lizard, *Phrynosoma coronatum frontale* (SC)

Amphibians

- Northern red-legged frog, *Rana aurora aurora* (SC)
- foothill yellow-legged frog, *Rana boylei* (SC)
- western spadefoot toad, *Scaphiopus hammondii* (SC)

Fish

- green sturgeon, *Acipenser medirostris* (SC)
- river lamprey, *Lampetra ayresi* (SC)
- Pacific lamprey, *Lampetra tridentata* (SC)
- longfin smelt, *Spirinchus thaleichthys* (SC)

QUAD : 483B SEARS POINT

Species of Concern

Invertebrates

Ricksecker's water scavenger beetle, *Hydrochara rickseckeri* (SC)

QUAD : 483D MARE ISLAND

Listed Species

Mammals

salt marsh harvest mouse, *Reithrodontomys raviventris* (E)

Birds

American peregrine falcon, *Falco peregrinus anatum* (E)

California brown pelican, *Pelecanus occidentalis californicus* (E)

California clapper rail, *Rallus longirostris obsoletus* (E)

western snowy plover, *Charadrius alexandrinus nivosus* (T)

bald eagle, *Haliaeetus leucocephalus* (T)

northern spotted owl, *Strix occidentalis caurina* (T)

Amphibians

California red-legged frog, *Rana aurora draytonii* (T)

Fish

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

winter-run chinook salmon critical habitat, *Oncorhynchus tshawytscha* (E)

delta smelt, *Hypomesus transpacificus* (T)

delta smelt critical habitat, *Hypomesus transpacificus critical habitat* (T)

coho salmon - central CA coast, *Oncorhynchus kisutch* (T)

Central California steelhead, *Oncorhynchus mykiss* (T)

Invertebrates

callippe silverspot butterfly, *Speyeria callippe callippe* (E)

California freshwater shrimp, *Syncaris pacifica* (E)

Plants

soft bird's-beak, *Cordylanthus mollis ssp. mollis* (E)

QUAD : 483D MARE ISLAND

Proposed Species

Fish

- Central Valley spring-run chinook salmon, *Oncorhynchus tshawytscha* (PE)
- Central Valley fall-run chinook crit hab, *Oncorhynchus tshawytscha* (PT)
- Central Valley fall-run chinook salmon, *Oncorhynchus tshawytscha* (PT)
- Sacramento splittail, *Pogonichthys macrolepidotus* (PT)

Candidate Species

Amphibians

- California tiger salamander, *Ambystoma californiense* (C)

Species of Concern

Mammals

- greater western mastiff-bat, *Eumops perotis californicus* (SC)
- long-eared myotis bat, *Myotis evotis* (SC)
- fringed myotis bat, *Myotis thysanodes* (SC)
- long-legged myotis bat, *Myotis volans* (SC)
- Yuma myotis bat, *Myotis yumanensis* (SC)
- San Francisco dusky-footed woodrat, *Neotoma fuscipes annectens* (SC)
- Pacific western big-eared bat, *Plecotus townsendii townsendii* (SC)
- Suisun ornate shrew, *Sorex ornatus sinuosus* (SC)
- salt marsh vagrant shrew, *Sorex vagrans halicoetes* (SC)

Birds

- tricolored blackbird, *Agelaius tricolor* (SC)
- Bell's sage sparrow, *Amphispiza belli belli* (SC)
- western burrowing owl, *Athene cunicularia hypugea* (SC)
- ferruginous hawk, *Buteo regalis* (SC)
- saltmarsh common yellowthroat, *Geothlypis trichas sinuosa* (SC)
- San Pablo song sparrow, *Melospiza melodia samuelis* (SC)

QUAD : 483D MARE ISLAND

Species of Concern

Reptiles

- northwestern pond turtle, *Clemmys marmorata marmorata* (SC)
- southwestern pond turtle, *Clemmys marmorata pallida* (SC)
- California horned lizard, *Phrynosoma coronatum frontale* (SC)

Amphibians

- foothill yellow-legged frog, *Rana boylei* (SC)
- western spadefoot toad, *Scaphiopus hammondii* (SC)

Fish

- green sturgeon, *Acipenser medirostris* (SC)
- river lamprey, *Lampetra ayresi* (SC)
- Pacific lamprey, *Lampetra tridentata* (SC)
- longfin smelt, *Spirinchus thaleichthys* (SC)

Invertebrates

- Ricksecker's water scavenger beetle, *Hydrochara rickseckeri* (SC)

Plants

- Suisun Marsh aster, *Aster lentus* (SC)
- Mason's lilaeopsis, *Lilaeopsis masonii* (SC)

KEY:

- | | |
|--------------------------------|---|
| (E) <i>Endangered</i> | Listed (in the Federal Register) as being in danger of extinction. |
| (T) <i>Threatened</i> | Listed as likely to become endangered within the foreseeable future. |
| (P) <i>Proposed</i> | Officially proposed (in the Federal Register) for listing as endangered or threatened. |
| (C) <i>Candidate</i> | Candidate to become a <i>proposed</i> species. |
| (SC) <i>Species of Concern</i> | May be endangered or threatened. Not enough biological information has been gathered to support listing at this time. |
| (*) | Possibly extinct. |
| <i>Critical Habitat</i> | Area essential to the conservation of a species. |